Space Weather Technical Forecast

Issued on Tuesday, 17 October 2023 at 13:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight Chance of G1/Minor Storm intervals throughout due to transitory coronal hole enhancement and potential CME glancing blows.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low, with occasional C-flares. Peak flare was C9.8 from a new sunspot region rotating onto the northeast limb. The largest spots are AR3464 and AR3465, which are both relatively mature spots near centre disc, and showed very little development. The other regions are all smaller and simple. A long period C7.5 also occurred from ex-AR3467 in the northeast, which subsequently decayed. This produced a CME, with analysis still ongoing. However preliminary assessment suggests either missing or a slight glance possible late day 3 or early day 4 (19-20 Oct). A further CME was observed 17/0500 UTC associated with a small C-flare in the southwest disk, we await imagery for analysis.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE were indicative of background slow wind. Solar winds speeds eased from 350 km/s to around 300 km/s. Density was below average. The interplanetary magnetic field (IMF), Bt, was weak below 4nT. The north-south component, Bt, was also weak varying -2nT to +3nT, but mainly positive (northward). Phi angle was negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at Background. GOES16 high energy (greater than 2MeV) electron flux was at Background throughout. Associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. The observation at 17/0000UTC was 1.56e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity is expected, with only slight chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: There are three CMEs with potential Earth-directed components currently analysed. Two from the 14th which, given similar speeds and source longitude and one shortly following the other, have the potential to follow each other closely, or more likely occur as a single glance. This is currently forecast for early day 2 (18 Oct). A further CME which was observed from the C7.5 of AR3467 on the 16 Oct in the northeast, preliminary analysis suggests a glancing impact possible late of day 3 (19 Oct) or early on day 4 (20 Oct). Some transitory influence possible from the fast wind associated with CH60/+ early in the period and CH62/- late in the period, but otherwise solar winds expected to be near background. Mainly Quiet geomagnetic activity expected, but occasional Unsettled to Active intervals likely, with a slight chance G1 Minor Storm intervals throughout the period from potential transitory coronal hole enhancements and CME glances. All low confidence.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux will most likely remain at Background levels. High energy electron flux (greater than 2MeV) is expected to

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rise late in the period in response to any enhancements that occur on day 1 and 2 (17 and 18 Oct), reaching Moderate, perhaps peaking High later into the period. The associated 24 hour fluence is expected to rise day 3 and day 4, but with only a slight chance of reaching Active (1e8 integrated pfu).

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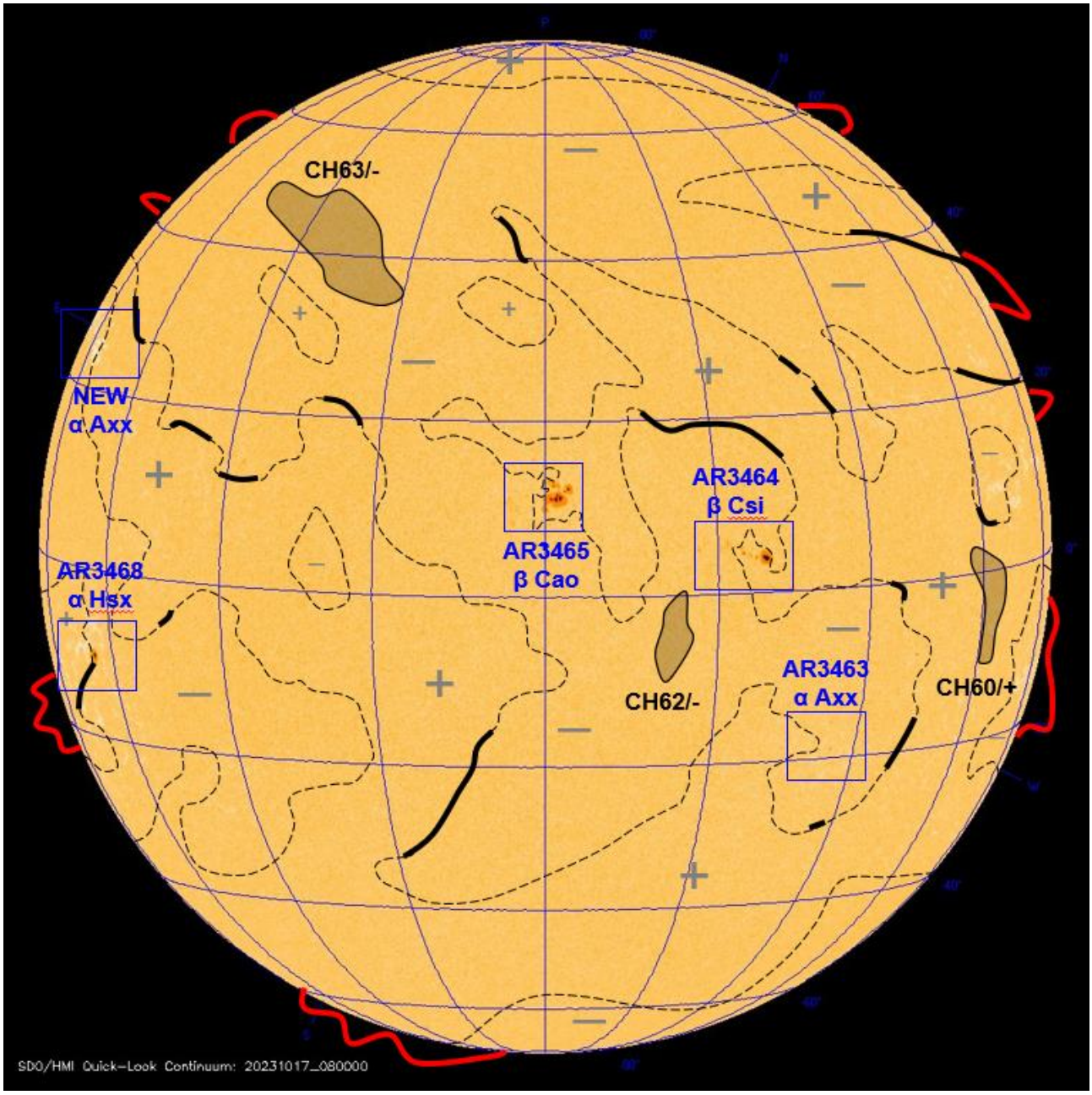
Figure 1. Solar Analysis Valid 17/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:
There are three CMEs with potential Earth-directed components currently analysed. The first is from a corona-based dimming near N35W030 starting around 14/0340UTC. The second from a CME observed due to a filament lift-off north of AR3466 at 14/1240UTC, around N15W025. Given similar speeds and source longitude and one shortly following the other, these CMEs have the potential to follow each other closely, or more likely occur as a single glance. This is currently forecast for early day 2 (18 Oct). A further CME which was observed from the C7.5 of AR3467 on 16 Oct in the northeast, preliminary analysis suggests a glancing impact possible late of day 3 (19 Oct) or early on day 4 (20 Oct).

Some transitory influence from the fast wind associated with CH60/+ remains likely during day 1 (17 Oct), later than originally forecast, but in line with the weak enhancement indicated in MOSWOC ENLIL model output. This currently suggests solar winds increasing on 17 Oct to around 400km/s. Given the positive polarity of the coronal hole, and the time of year, this does bring the potential for G1 Minor Storm intervals albeit with low confidence. Any fast wind enhancement, coupled with potential for glancing CME arrival, is expected to ease later day 2 onward, with winds easing back towards background, though a further glancing CME enhancement is possible associated with the CME observed on the 16th. Any potential enhancement to solar winds from the small CH62/- is currently not expected until late day 4, (20 Oct).

Mainly Quiet geomagnetic activity expected, but occasional Unsettled to Active intervals likely, with a slight chance G1 Minor Storm intervals throughout the period from potential transitory coronal hole enhancements and CME glances. All low confidence.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	20	10	20
Strong	G3	No	1	1	1	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
14/1337	Partial	Filament	NW	448 km/s	18/0900 UTC	Low confidence, glancing
14/2152	Partial	Filament	NW	431 km/s	18/0900 UTC	Low confidence, glancing
16/1050	Partial	C7.5 AR3467	NE	680 km/s	20/0000 UTC	Low confidence, glancing

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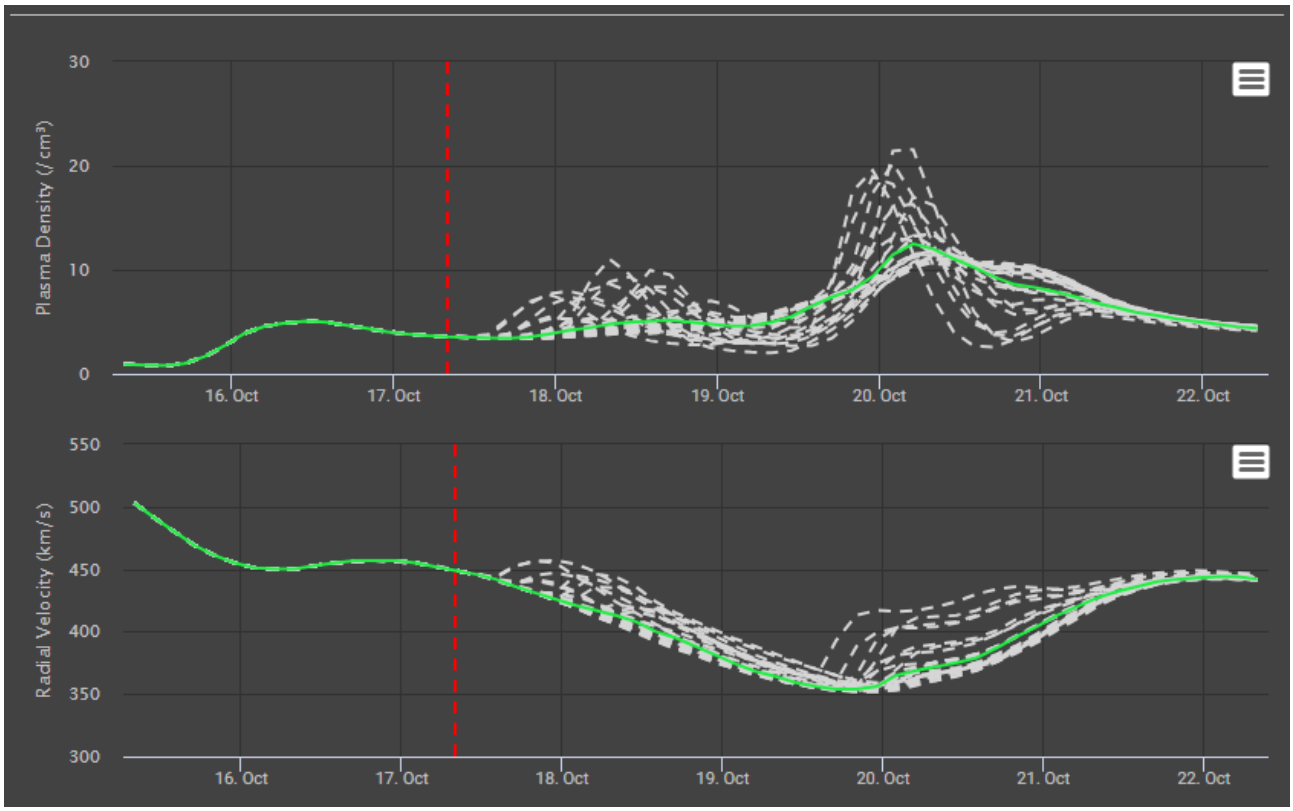
Figure 2: Latest MOSWOC ENLIL Ensemble output, showing potential for glancing blows associated with the above CMEs. Note however ENLIL currently has a poor understanding of current solar winds with errors in the coronal hole analysis. This lowers confidance in the forecast.



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Radio Blackouts - X-Ray Flares:
Low activity is expected, with only a slight chance of M-flares. This risk likely slowly increases through the period, due to the likelihood of further regions either developing or rotating onto the disc.

There are currently only five small and relatively simple sunspots on the disc. The most prominent remain AR3464 and AR3465, not far from the centre disc have remained relatively stable. The most recent C-flares were observed from emergent and unnumbered spot locations, however due to their limb locations they are both difficult to observe, consisting largely of faculae. A further C7.5 flare was observed from the ex-AR3467 in the northeast, however this subsequently faded, other declined regions include ex-AR3466, and ex-AR3467

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	20	25	30	35
Very Active	R3 to R5 X Class	No	1	1	1	1

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Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux observed by GOES16 is most likely to persist at Background levels. Any increase to proton flux is unlikely, given the current visible sunspot activity.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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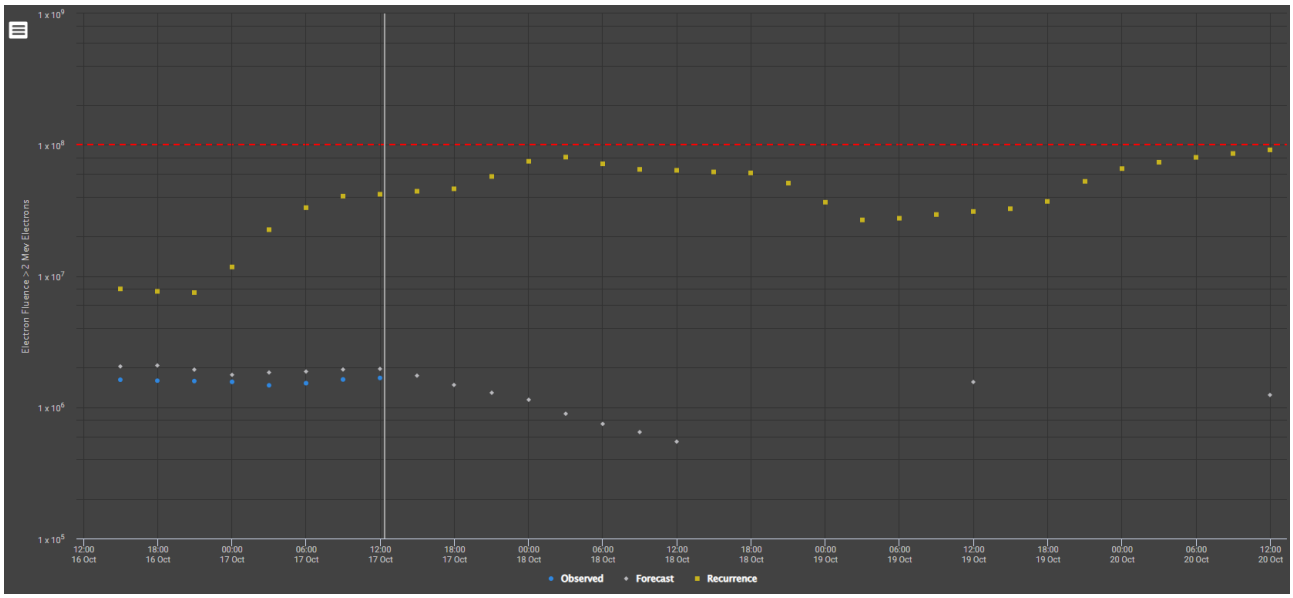
High Energy Electrons Event (≥ 2MeV):
Electron flux observed by GOES-16 at GEO are currently at background, however the Van Allen belts may see electron population increase day 1 and day 2 (17-18 Oct). Primarily due to the potential influence of a fast winds of CH60/+ on day 1 (17 Oct), but with a more uncertain influence from any CME glance that occurs early on day 2 (18 Oct). As solar wind pressure then eases the flux at GEO is likely to rise day 3 and day 4 (19-20 Oct), becoming more persistently Moderate with a chance of reaching High, mainly at diurnal peak periods. These enhancements are low confidence however, and it is possible that background electron flux will persist throughout.

The associated fluence is likely to remain below the Active threshold, however confidence decreases later in the period due to the potential for enhancement from CH60/+ fast wind and the CME impact. REFM is giving a good guidance to expected conditions in the absence of any enhancement, however this will become more unreliable once any fast wind or CME arrival occurs.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	10	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: Latest MOSWOC REFM model output



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